Test questions **Derivative Formulas**

1. Calculate the $\frac{dy}{dx}$ the following functions. Show the work that leads to your answer. Simplify your answer if possible.

   a. $y = x^3 \tan(x)$

   b. $y = \frac{5-7x}{3x-2}$

   c. $y = \sin(\ln x)$

   d. $y = e^{3x^2} + 7\sqrt{x} + \frac{1}{x}$

   e. $y = \left(3x^2 + 5x - \cos(x)\right)^2$

2.

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	8	0	7	–5
2	4	3	4	2
3	1	4	4.75	2.5
4	–3	7	5	3

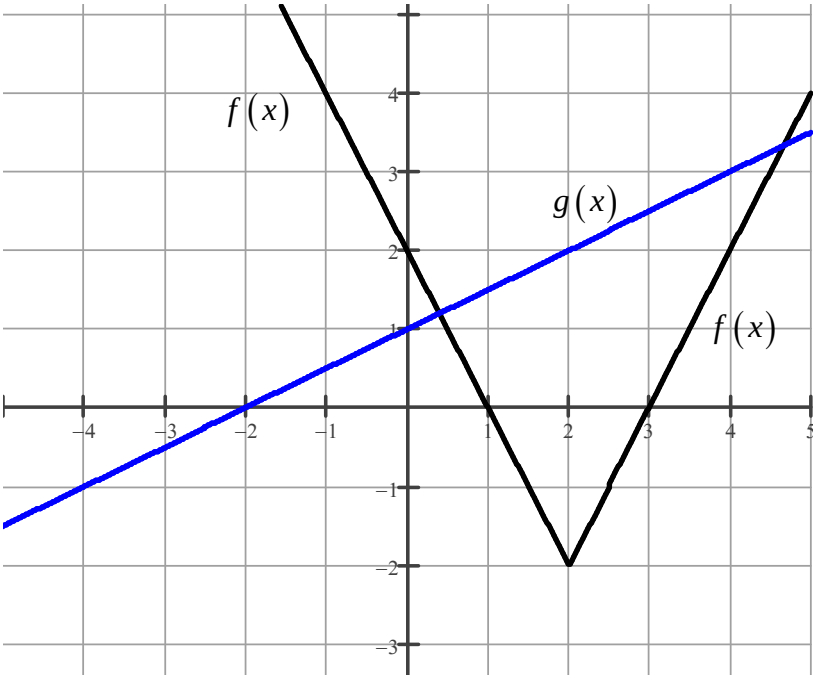
The functions *f* and *g* are differentiable for all real numbers. The table above gives values of the functions and their first derivatives at selected values of *x*. Show the work that leads to your answer.

a. Let $h(x) = f(x)g(x) + x$. Calculate $h'(2)$

b. Let $k(x) = g(f(x))$. Calculate $k'(3)$

c. Let $r(x) = \frac{f(x)}{g(2x)}$. Calculate $r'(2)$

3.



The graph above shows the function *f* consisting of two line segments and the graph of *g*, a line. Show your work.

a. Let $h(x)=\dfrac{f(x)}{g(x)}$. Calculate $h(0)$ and $h'(0)$

b. Let $k(x)=f(x)-\dfrac{1}{g(x)}$. Calculate $k(4)$ and $k'(4)$

c. $q(x)=g(f(x))$. Calculate $q(2)$ and $q'(2)$

4. Consider the function $f(x)=2-e^{-x}$

a. Find $\lim\limits_{x\to\infty} f(x)$

b. Describe the graph of f as $x\to\infty$

c. Find $\lim\limits_{x\to\infty} f'(x)$

d. Explain how to find $\lim\limits_{x\to\infty} f'(x)$ *without* first finding $f'(x)$.

Answers

1. [Parts a, b, c and e: 3 points each, 1 for correct formula, 1 for correct use of chain rule 1 for answer 0/3 if wrong formula; except part d. 1 point for each term

   a. $y' = x^3\left(\sec\left(x\right)\right)^2 + 3x^2\tan\left(x\right)$

   b. $y' = \dfrac{-1}{\left(3x-2\right)^2}$

   c. $y' = \dfrac{\cos\left(\ln\left(x\right)\right)}{x}$

   d. $y' = 6xe^{3x^2} + \dfrac{7}{2\sqrt{x}} - \dfrac{1}{x^2}$

   e. $y' = 2\left(3x^2 + 5x - \cos\left(x\right)\right)\left(6x + 5 + \sin\left(x\right)\right)$

2. [2 each: 1 for formula, 1 for answer.]

   a. 21

   b. –20

   c. $-\dfrac{9}{25}$

3. [3 each; 1 for value, 1 for derivative formula, 1 for derivative answer.]

   a. 2, –3

   b. $\dfrac{5}{3}, \dfrac{37}{18}$

   c. 0, Not differentiable at $x = 2$

4. [1 point each part]

   a. 2

   b. The graph has a horizontal asymptote of $y = 2$ as $x \to \infty$

   c. 0

d. Since the graph has a horizontal asymptote its slope is approaching zero, therefore $\lim_{x\to\infty} f'(x) = 0$